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Claims

1. An apparatus for delivering a plurality of fluids to a chemical vapor deposition chamber, having a cavity comprising:

3 an inlet nozzle having a first diameter to receive one of said plurality of fluids as a
4 carrier fluid, and configured to maintain a first pressure and a first
5 temperature;

6 a throat region having a first and second end, connecting to said inlet nozzle at
7 said first end, having a second diameter less than said first diameter, and
8 configured to maintain a second pressure and second temperature; said throat
9 region having at least one aperture adjacent to said first and second ends to
10 allow for the introduction of at least one of said plurality of fluids to said
11 carrier fluid; and,

12 an exit nozzle, connect to said throat region at said second end, having a third
13 diameter greater than said second diameter, and configured to maintain a third
14 pressure and third temperature.

1 2. The apparatus of claim 1 wherein said inlet nozzle having said first diameter
2 tapers down to said throat region second diameter at an angle in the range of forty to
3 sixty degrees.

1 3. The apparatus of claim 1 wherein said throat region is configured to operate at
2 a critical Mach number of 1.0.

1 4. The apparatus of claim 1 wherein said second pressure and said second
2 temperature are selected to present a condition for atomization of said fluids.

1 5. The apparatus of claim 1 wherein some of said plurality of fluids are
2 precursors, and others of said plurality of fluids are dopants.

1 6. The apparatus of claim 1 wherein said throat region further comprises two or
2 more apertures adjacent to said first and second ends to allow for the introduction of
3 two or more of said plurality of fluids to said carrier fluid, each of said two or more
4 of said plurality of fluids introduced separately through individual apertures.

1 7. The apparatus of claim 1 wherein said throat region is configured to maintain
2 said first pressure to be greater than said third pressure.

1 8. The apparatus of claim 1 wherein said second pressure is an elevated and
2 constant pressure above vacuum conditions.

1 9. The apparatus of claim 1 wherein said carrier fluid is delivered at a constant
2 flow rate ensuring said second pressure being maintained constant through said throat
3 region.

1 10. The apparatus of claim 1 wherein said plurality of fluids are introduced
2 separately and simultaneously without pre-mixing.

1 11. The apparatus of claim 1 further comprising a heater for applying heat to said
2 plurality of fluids exiting said exit nozzle.

1 12. The apparatus of claim 1 wherein said exit nozzle at said third diameter tapers
2 down to said throat region second diameter at an angle in the range of twenty to forty
3 degrees.

1 13. An apparatus for delivering a plurality of fluids to a chemical vapor deposition
2 chamber, having a cavity comprising

3 an inlet nozzle having a first diameter to receive one of said plurality of fluids as a
4 carrier fluid, and configured to maintain a first pressure and a first
5 temperature;
6 a throat region having a first and second end, connecting to said inlet nozzle at
7 said first end, having a second diameter less than said first diameter, and
8 configured to maintain a second pressure and second temperature; said throat
9 region having at least one aperture adjacent to said first and second ends to
10 allow for the introduction of at least one of said plurality of fluids to said
11 carrier fluid; and,
12 an exit nozzle, connect to said throat region at said second end, having said second
13 diameter, and configured to maintain said second pressure and said second
14 temperature, such that said exit nozzle is an extension of said throat region having
15 the same dimensions as said throat region.

1 14. The apparatus of claim 13 wherein said inlet nozzle having said first diameter
2 tapers down to said throat region second diameter at an angle in the range of forty to
3 sixty degrees.

Suh D 1) 15. The apparatus of claim 13 wherein said throat region is configured to operate
at a critical Mach number of 1.0.

Suh D 2) 16. The apparatus of claim 13 wherein said second pressure and said second
temperature are selected to present a condition for atomization of said fluids.

1 17. The apparatus of claim 13 wherein some of said plurality of fluids are
2 precursors, and others of said plurality of fluids are dopants.

1 18. The apparatus of claim 13 wherein said throat region further comprises two or
2 more apertures adjacent to said first and second ends to allow for the introduction of

3 two or more of said plurality of fluids to said carrier fluid, each of said two or more
4 of said plurality of fluids introduced separately through individual apertures.

1 19. The apparatus of claim 13 wherein said second pressure is an elevated and
2 constant pressure above vacuum conditions.

1 20. The apparatus of claim 13 wherein said carrier fluid is delivered at a constant
2 flow rate ensuring said second pressure being maintained constant through said throat
3 region.

1 21. The apparatus of claim 13 wherein said plurality of fluids are introduced
2 separately and simultaneously without pre-mixing.

1 22. A method for introducing a plurality of fluids into a chemical vapor deposition
2 process chamber comprising:

3 injecting at least one of said plurality of fluids as a carrier fluid in line at a
4 constant flow rate and under conditions of a first pressure and first
5 temperature;

6 injecting others of said plurality of fluids separately, simultaneously, and without
7 pre-mixing, as precursors and dopants in line with said carrier fluid and under
8 conditions of a second pressure and a second temperature; and,

9 exiting said fluids to said chamber such that said fluids undergo atomization and
10 vaporization.

1 23. The method of claim 22 further comprising exiting said fluids to said chamber
2 at a third pressure and third temperature.

and C5
add P17